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Evaluating electronic learning supports

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Abstract

The paper presents the procedure for verifying and optimizing of electronic learning supports' evaluation system in virtue of a research investigation performed in the Czech Republic.
The research investigation performed was conceived as multi-phase. The first two phases of the research were focused on verifying the electronic learning supports' evaluation system, using factor and cluster analyses. The third and fourth phases of the research were aimed at optimizing the system of evaluation by means of multidimensional and parametric statistical methods.

Keywords: electronic learning support; distance learning; e-learning; assessment; evaluation criteria; factor analysis; cluster analysis; evaluation system.

1. E-learning as a perspective way of learning

As education has accompanied mankind from the earliest times, it has continually been developed and subject to gradual innovation. The absolute phenomenon of the late 20th and early 21st century has been e-learning, which consists of many sub-elements, often interlinked to form a comprehensive integrated system allowing for effective learning. The later may either take the form of large-scale, fully distance courses using sophisticated cooperative learning tools, or it can be realized just as a complement to full-time study courses.

E-learning has become an area with good prospects for growth, and as such has been continuously, systematically and extensively dealt with at the international level, as confirmed by the works stated below: Eom, S. B. – Arbaugh, J. B. (2011), Clark, R. C. - Mayer, R. E. (2011), Joo, Y. J. – Lim, K. Y. – Kim, E. K. (2011), Mauthe, A. - Thomas, P. (2004), Anderson, J. - McCormick, R. (2005), Bennett, S, - Maton, K. - Kervin, L. (2008), Kluge, S. - Riley, L. (2008), Möhlenbrock, R. (1982), Paulsen, M. F. (2003), Smith, D., S., Caruso, J., B. (2010), Tapscott, D. (1998), Bates, A. - Poole, G. (2003), Ramanau, R. - Hosein, A. - Jones, Ch. (2010), Zounek, J. (2009), Barešová, A. (2003),

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Nocar, D. a kol. (2004), Eger, L. (2002), Zlámalová, H. (2002), Bednaříková, I. (2008), Kopecký, K. (2006), Květoň, K. (2004), Průcha, J. - Míka, J. (2000), Šimonová, I. (2010).

Since the concept of e-learning has been perceived and defined in different ways, our definition shall be unambiguous and in conformity with the context of the study. In Anglo-Saxon countries, the notion of e-learning (Lowenthal, Wilson, 2009) with respect to education activities supported by ICT (e-support) is often replaced by relatively steady concepts of Computer-Based Training (CBT), Internet-Based Training (IBT) or Web-Based Training (WBT) (Zounek, 2009). In general, e-learning is understood as a type of learning, within the framework of which the acquisition and the use of knowledge is distributed and facilitated by electronic devices (Prucha, J. et al., 2009).

E-learning comprises not only a number of tools that are used for the presentation and the transfer of the educational content, and for the management of the studies, but also an entire spectrum of communication channels. The tools can be used thanks to the Learning Management System (LMS), which is a prerequisite for a truly effective learning process using e-learning. LMS therefore represents a virtual "classroom", where learning supports, examination papers, learning instructions, exercise plans or discussion forums are placed (Mauth, Thomas, 2004). Apart from LMS, among the basic tools of implementation of e-learning are properly structured and didactically adapted educational texts, abbreviated as e-learning supports or just learning supports (see Paulsen, 2003; Gray, 2010; Kopecky, 2006). Electronic study supports are specific in many aspects; as they are intended for a form of study, mainly characterized by a higher level of independence and individuality (Bates and Poole, 2003).

According to contemporary approaches to the evaluation of e-learning courses and/or study texts, "there are two essential criteria for assessing the quality of e-learning, i.e. it should work without problems for all participants as regards the technical aspects, and the application of pedagogical principles must be evident" (Eger, 2004).

However, modern information and communication technologies allow for the application of a much wider range of possibilities of teaching principles than in the past. In the forefront of teachers` and students` interest has become the educational content, the carrier of which is no longer just text and static visual information, but also dynamic visual information, animations, simulations, or even virtual reality (Maresova, 2009).

2. Research methods and data treatment procedures used

In the theoretical part of the study, the excerption method, comparative analysis and synthesis were used. The inductive-deductive method was applied as well.

In order to ensure the same conditions under which the research investigation was carried out at PdF in Olomouc, at the other tertiary education institutions was a questionnaire used, too, to collect the research data. Its use enabled the application of the same statistical methods and thus allowed for the subsequent comparability. A questionnaire operating with two types of questions was created - polynomial scale for assessing the importance of individual evaluation criteria and dichotomous to determine the basic characteristics of the respondents. The questionnaire was distributed among students of eight tertiary education institutions in the country.

3. Current approaches to the evaluation of distance and/or e-learning courses

The classical approach to the evaluation of training courses, formerly known as "training programs" stemmed from Kirkpatrick`s four-level evaluation model, later revised and updated in the 1993 book entitled Evaluating Training Programs: The Four Levels (Kirkpatrick, 1993). This model, which is still applied for the purpose of evaluating the effectiveness of e-learning courses, is based on the elementary postulate of distance education, i.e. that distance education equals adult education and as such can be applied not only in business and public sectors, but also in the sphere of tertiary and lifelong education (Bednaříková, 2008) .

Other systems are based on a qualitative approach to the evaluation as a new strategic business management philosophy. The concept of Total Quality Management has been introduced (Blecharz, Zindulková, 2005). Thanks to some projects, such as already existing SEEQUEL, The Concept of quality in e-learning (Seequel, 2004) or the General framework for quality in e-learning (Anderson, McCormic, 2005) have been established, and the system of quality management in e-learning has thus gradually been formed.

That implies that there exist more questionnaires assessing e-learning from this perspective (e.g. Quality on the line: benchmarks for success in Internet-based distance education, the aforementioned project SEEQUEL), of which

some originated in the Czech Republic as well, such as Standards of evaluation from the Faculty of Economics of the University of West Bohemia in Pilsen (Eger, 2005). A systematic review of the instruments for the evaluation of e-learning is developed in the publication of M. Klement (Klement, 2011), to which the reader is hereby referred.

This approach to the evaluation of e-learning looks at the process of education as a seamless whole, and does not differentiate the educational process as such, i.e. its stages, layout, and/or the structure of learning content or even its form.

4. Current approaches to the evaluation of the learning materials designed for distance and e-learning courses

Another approach to the evaluation of e-learning, which the authors of the submitted paper identify themselves with, stems from the fact that it is possible to assess and evaluate individual components of e-learning, one of the elementary being the distance learning texts.

In accordance with this concept, several studies and research investigations were carried out, focused on the quality standards of the components of e-learning. As regards foreign experts, works by M. Simonson, S. Smaldina, M., and J. Allbrighta Frydengerga (Frydengerg, 2002) are of interest. As regards the domestic production, publications by Květoň K., L. Koníček, D. Bauer (Bauer, 2007), E. Mechlová, J. Šarmanová, and M. Malčík should be mentioned. The last three named are co-authors of yet another publication entitled "Support for the accreditation of distance education through e-learning" (Mechlová, Šarmanová, Malčík, 2008), too. In this one they set four basic areas with respect to the evaluation of learning supports, as they follow:

- basic properties of the text,
- activation of students,
- planning and organization of learning activities,
- feedback and evaluation.

Even though this approach to the evaluation of electronic distance learning text may seem very appropriate and balanced, it does not accent all the contemporary trends in the implementation of e-learning, e.g. its elaborate components, such as remote experiment, modelling learning situations or virtualization. These educational strategies, based mainly on the psychomotor and affective objectives of education, are nowadays getting to the forefront of students (Maresova, 2009), as well as teachers.

5. Current approaches to the evaluation of the learning materials designed for e-learning courses

The design and the construction itself of an optimized system of the evaluation of educational materials intended for distance learning and e-learning focuses on several assumptions, based on the above mentioned facts.

- The traditional concept of distance education is based on the fact that the main carrier of information (knowledge, skills, attitudes, etc.) is primarily the text or rather the text in the form of distance learning text (often referred to as a study support).
- E-learning allows for the use of distance learning study texts in the electronic form (often referred to as electronic study supports), which comprise several carriers of the educational content, very often in the nature of multimedia.
- Experimental work in virtual labs and simulations enable the achievement of psychomotor educational goals.
- The use of the above mentioned forms of distance learning requires a choice of an appropriate training strategy that reflects the possibility of using specific carriers of the educational content, matching the objectives achieved.

Based on these assumptions, it is thus possible to design an optimized system of evaluation criteria, which can be divided into six basic areas. They are as follow:

- criteria focused on the personality of the student and on distance learning
- criteria focused on student`s learning and distance learning,
- criteria focused on the educational content and its form with respect to distance learning,
- criteria focused on the specifics of distance learning
- criteria focused on the technical aspects of distance learning and LMS
- criteria focused on the ergonomic aspects of distance learning and LMS.

The individual areas of the optimized system of the evaluation of educational materials intended for distance learning and e-learning are filled up with a total of 78 evaluation criteria, arising from the theoretical analysis, which define the individual properties, behaviour, operation, content or structure of every considered part of the educational material.

6. The verification of the optimized system, based on a research investigation

The theoretical proposal for an evaluation system was subjected to a statistical analysis aimed to verify the research assumption that the proposed system of the evaluation of educational materials intended for distance learning and e-learning can be divided into six basic groups of evaluation criteria. This assumption was subjected to a verification process, using multivariate (multidimensional) statistical methods, and cluster and factor analyses. The research sample consisted of 1625 students of eight tertiary education institutions within the Czech Republic, who have had experience with e-learning throughout their studies. The research sample structure is shown in the following Table No. 1.

Table 1.Structure of the research sample

Structure of the research sample n = 1625								
Tertiary institution	Respondents				Age structure			
	Students approached	Students involved	Of which women	Of which men	15 - 30	30 - 45	45 - 60	unstated
Sts. Cyril and Methodius Faculty of Theology, Palacký University Olomouc	108	31	17	14	18	7	4	2
Faculty of Economics, University of West Bohemia Pilsen	1148	417	323	94	374	24	4	15
Faculty of Physical Culture, Palacký University	571	109	45	64	81	16	4	8
Faculty of Arts, Palacký University Olomouc	2045	698	465	233	216	189	257	36
Justice Academy, Kroměříž	247	23	11	12	14	8	0	1
Faculty of Education, Palacký University Olomouc	2008	287	205	82	200	58	13	16
Faculty of Education, University of Hradec Králové	39	32	24	8	2	17	13	0
Faculty of Law, Palacký University Olomouc	77	28	17	11	15	10	1	2
Total	6243	1625	1107	518	920	329	296	80

The first step of the verification process was the implementation of the method of cluster analysis, which allowed for an analysis of the assessment of individual evaluation criteria by the respondents. The result of this analysis is presented in the Graph 1 below.

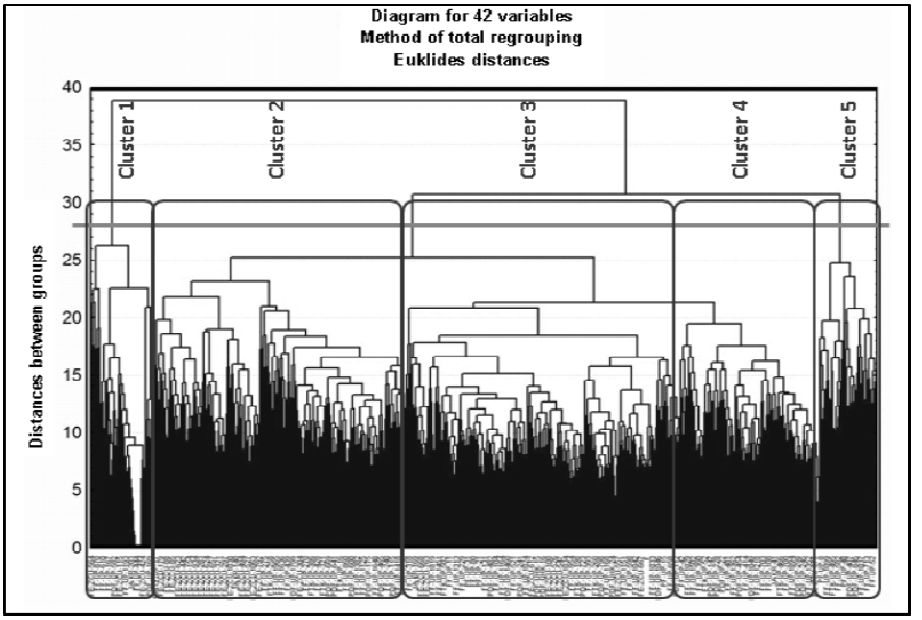

Chart 1. Cluster analysis of students` assessment of the evaluation criteria

As emerged from the cluster analysis, students can be divided into 5 basic groups according to the degree of similarity related to the assessment of individual criteria. Therefore, we performed yet another cluster analysis focused on whether it was possible to divide the individual evaluation criteria into 6 groups, according to the original research assumption. The results of this stage of the cluster analysis are presented in the Graph 2 below.

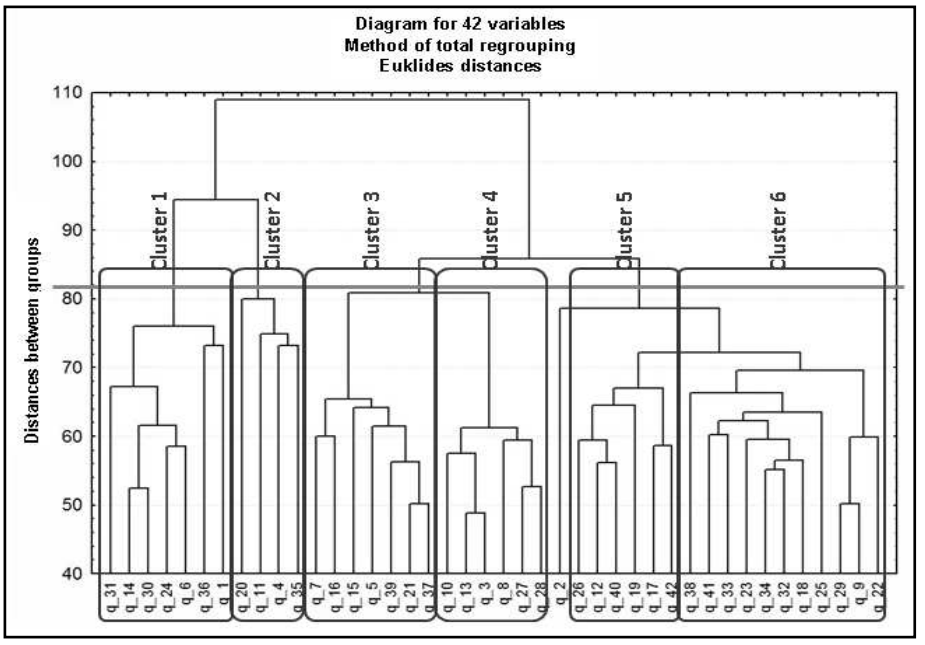

Chart 2. Cluster analysis of the assessment of the evaluation criteria

As shown in the graph, it was actually possible to divide the evaluation criteria into six areas of evaluation. It was also possible to substantiate this claim by means of the factor analysis, which followed. On the basis of the number

of eigenvalues greater than 1, the number of extracted factors was set down to 6 as well, which again corresponded to the aforementioned research assumption. The results of this sub-factor analysis are presented in the Table 2 below.

Table 2. Eigenvalues and variance percentage explained by factors

Factor	Eigenvalues: Number of variables – 42 *Extraction: Main components; Rotation: Varimax normal*			
	Eigenvalue	Total percentage variance	Cumulative eigenvalue	Cumulative variance percentage
1	9,55567	22.75162	9.55568	22.75162
2	6,01052	15.16792	15.5662	37.91954
3	3,20373	8.29462	18.76993	46.21416
4	2,16622	5.72911	20.93615	51.94327
5	1.34233	3.19602	22.27848	57.67238
6	1.26789	3.01879	23.54637	60.69117

The six extracted factors explained for 60.69% of the total variance and it was therefore possible to say that the research assumption could be accepted and the proposed system of the evaluation of electronic study regarded as proven and substantiated.

7. Discussions

There is a clear trend towards the computerization of distance learning, stemming not only from the educational institutions, which are seeking ways to ensure the highest possible efficiency of combined forms of study, but also from the needs of the students, who regard the distant part of the study realized by means of e-learning as an important and necessary one, in the long term. Although there exists a small group of students who reject these educational activities, their number is so low that it would be neither economically nor organizationally possible to ensure their education on a full-time basis. However, it is possible to conceive the electronic learning supports and LMS systems so that they include some communication elements that can appropriately enhance the personal contact between the students and their tutors. It is thus necessary to assess the educational materials designed for distance education from this perspective as well, and the evaluation tools should respect the fact, too.

There is also a clear trend towards interactivity as one of the important elements of the modernization of distance education through e-learning, which is also based on the long-term needs of the students. The fact shall be accepted and the proportion of dynamic elements in the form of interactive simulations in electronic study supports shall be increased. Moreover, it is necessary to reflect this fact in the evaluation tools, which should contain elements capable of specifically detecting the interactive elements and distinguishing them from the static visual elements.

8. Conclusions

After a theoretical analysis of the systems of evaluation of e-learning and distance learning courses and/or texts, a conclusion was reached that the existing evaluation systems, based primarily on the assessment of text features, are not always convenient, because they do not accent all the relevant modernization trends.

That is why a new and optimized system of the evaluation of educational materials intended for distance learning and e-learning was designed and developed. This particular evaluation system was then put to the test on the basis of multivariate statistical methods. It can be concluded that the proposed optimized system of the evaluation of educational materials intended for distance learning and e-learning stood the test based on the application of the aforementioned multivariate statistical methods and thus proved to be correct.

Despite the fact that the correctness of the designed system of the evaluation of electronic supports was proved by means of statistical methods, it must be said for the sake of objectivity that so far the investigation research has only been carried out at just one educational institution. The research investigation will therefore continue, within the framework of the GACR project No.P407/11/1306, in the form of collecting further research data. Once

a sufficient number of responses from the respondents from 4 other universities have been obtained, they will be subjected to the same multivariate analysis.

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